Name: _____
Class/Date: _____

MIT Edgerton Center Molecule Set: Understanding Air

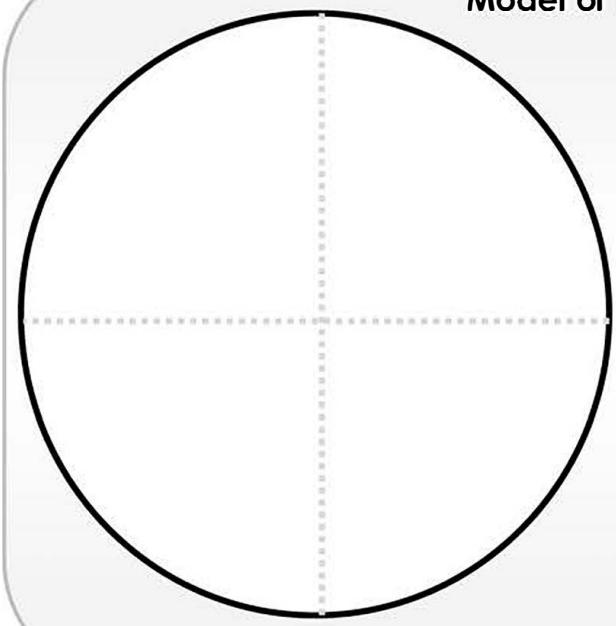
Climate Change

Part 1: What is Air?

Activity 1 What is air made of? Guess! A B C D *(Circle the letter.)*

Activity 2 Build with LEGO! Next, draw the model below. (Copy the whole LEGO mat.) Use the key provided for the brick colors. Label the molecules and add the percents.

Model of the Molecules in Air:



Key for the drawing:

Draw this = Color = Element

= white = _____

= black = _____

= blue = _____

= red = _____

CO_2 level written on the LEGO mat = _____PPM
Safe upper limit for CO_2 level = _____PPM

PPM = Parts Per Million (parts per 1,000,000)

Activity 3 Practice figuring out PPM:
Calculate the PPM of 80% nitrogen in air
Calculate the PPM of 20% oxygen in air

N_2= _____ PPM
O_2= _____ PPM

Show your work ***(hint: use fractions)***

https://edgerton.mit.edu/molecule-sets

Part II: Burning Fuel: Complete Combustion

Activity 1 Complete combustion is a chemical reaction in which all the fuel is burned. Record the complete combustion reaction from the LEGO mat. Use chemical symbols.

Reactants
(What we burn)

Products
(What we find in the exhaust)

Part III: Global Warming and the Greenhouse Effect

Activity 1 Use your computer or smartphone to go to the National Oceanic and Atmospheric Administration (NOAA) website:
https://gml.noaa.gov/ccgg/trends/graph.html

Examine the graph "Mauna Loa Monthly Averages." This is a graph of CO_2 averages over time in Hawaii. The carbon dioxide data on Mauna Loa constitute the longest record of direct measurements of CO_2 in the atmosphere. You will need to mouse over the chart to find specific CO_2 measurements. Use the blue dot to read off values in January of 2000, 2010, and 2020. Round to whole numbers.

Year	January CO_2 PPM
2000	
2010	
2020	

What was the increase in CO_2 PPM between Jan 2000 and Jan 2010?

1) The CO_2 increased _____PPM.

What was the increase in CO_2 PPM between Jan 2010 and Jan 2020?

2) The CO_2 increased _____PPM.

Work space

Based on these measurements, predict what the CO_2 PPM will be in 2030:

3) I predict the CO_2 measurement in 2030 will be _____PPM.

Explain how you made this prediction:_____

_____

_____

(This is your best educated guess.)

The Molecule Reference Sheet

A) Chemical Vocabulary.

Matter is anything that has mass and takes up space.
There are 3 major types of matter: elements, compounds, and mixtures.
Examples of matter are: a hat, ______________, ________________, _______________. *Is air matter? Y / N*

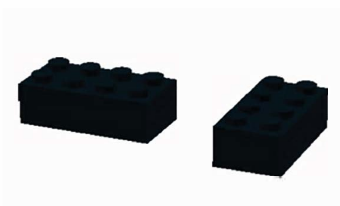
1) Element - a pure substance that has only one kind of **atom** in it.

Examples of elements:

____

____

____



These bricks are black. What element do they represent?

Atom - the smallest unit of an element. Atoms can exist either alone or in combination with other atoms.

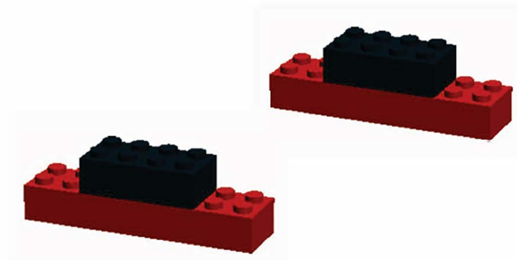
2) Compound - a pure substance made up of 2 or more different kinds of atoms bonded together. New properties appear.

Examples of compounds:

____

____

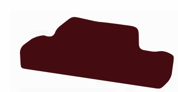
____



Make the compound carbon dioxide. The chemical formula is CO_2

Now make a water molecule. What might it look like?

Molecule – a combination of atoms bonded together. It comes from a Latin word meaning "little lump."



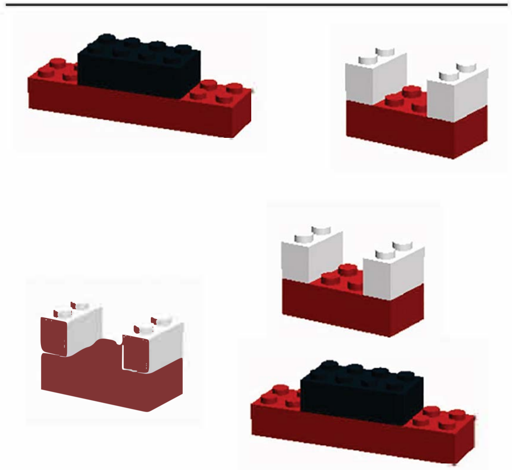
3) Mixture - a combination of two or more pure substances (elements or compounds) that can be separated by physical methods. The substances keep their original properties.

Examples of mixtures:

____

____

____



Make some carbonated water (soda). It is a mixture of CO_2 and H_2O. Could you still separate the molecules? How?

Matter can change in appearance. Is it a physical change or a chemical change? Here's how to decide:

4) Physical change - *molecules are the same before and after the change, although the matter may look different.*

Examples:

_____

_____

_____

Hints:

1) Physical changes include making mixtures, dissolving one thing in another, and cutting or breaking something.
2) All **changes of state** are physical changes. A water molecule is the same water molecule when it is ice, when it is liquid water, and when it is water vapor in the air.

5) Chemical change - *new and different molecules are formed.*

Examples:

_____

_____

_____

Hints:

1) All **chemical reactions** are chemical changes.
2) New properties appear.
3) The bonds between the atoms are broken and the atoms recombine in new ways.

B) Practice Writing Chemical Formulas.

A chemical formula is an easy way to tell what atoms are present in a compound.

Use the "Atom Key" to find the **chemical symbol** for each element.

It is important to write your formula using the correct uppercase or lowercase letters. The subscript number refers to the atom before it. Remember that "H_2O" means there are 2 hydrogen atoms and 1 oxygen atom. We write the subscript 2 for the hydrogen but it is unnecessary to write the 1 after the oxygen.

Chemists have a complicated set of rules about the order of atoms in their formulas. For this activity, we'll keep it simple, and list the atoms in order starting from the top of the Atom Key.

Directions.

1) Build the compound on the "Chemical Formula Practice Mat." (This would not be a real compound!)

2) Watch your teacher demonstrate how to write a formula.

3) Write out the formula for the compound here (write the symbols in the order of the Atom Key, from top to bottom):

_____

4) Now you and your teammate will each build your own made-up compound and write the formula for it below.

5) Trade compounds with your teammate and write out the formula for your TEAMMATE'S compound below.

6) Check that you and your teammate have the same answers!

_____ My formula

_____ My Teammate's formula

Look! These formulas follow more complicated rules but are still neat to see!				
CH_3COOH is the formula for vinegar!	$C_{19}H_{14}O_5S$ is the formula for phenolsulfonphthalein or phenol red!	CH_4 is the formula for methane gas!	$C_6H_{12}O_6$ is the formula for glucose!	NaOCl is the formula for bleach!